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BOTANICAL SKETCHES FROM THE ASIATIC TROPICS

By Henry Allan Gleason

(*Continued from July Torreya*)

III. JAVA

The steamers of the Dutch lines ply directly between Europe and Java, but the ordinary way by which the tourist reaches that island is from Singapore. The short trip is itself interesting, because at almost all times the vessel is in sight of some mountainous island, and through the field glasses one may get glimpses of the tropical vegetation along shore. On the second morning, the great mass of the Gedeh volcano suddenly appears in the sky to the southward, and a few hours later the steamer is in the harbor of Tanjong Priok.

This place is the seaport of Batavia, the largest city of the island, located some six miles inland, and connected with its port by rail. The old city of Batavia is now completely merged with the new city of Weltevreden, recently built by the Dutch. The newer part has broad streets, immense public squares, and several government buildings. It gives one the impression of having been patterned, in some degree, after the city of Washington, without having attained either the beauty or the dignity of our own city.

The through trains, which traverse the entire length of the island, start at Batavia, pass through Weltevreden, and then run inland to and beyond Buitenzorg. The ride of forty miles to the latter city is extremely interesting, and one almost re-

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grets that it is ended so soon. Always on one side or the other of the train, and sometimes on both sides, huge forested mountains are in view. The gently rolling valley land along which the train passes is intensively cultivated and very densely populated. The villages are shaded by slender betel palms, heavy sugar palms, tall coconuts, and huge spreading trees of durian, rambutan, and mangosteen, so that only the marginal houses are visible. So dense is the population that the train is hardly out of one village before it enters another, and their groves of fruit trees and palms blend at a little distance so that the whole country appears one vast forest. But for forty miles not a bit

FIG. 12. *Parkia intermedia* as seen from the railway between Batavia and Buitenzorg, Java.

of real forest is passed, and one can easily understand the fact that the whole island is under cultivation up to an altitude of five thousand feet. To see the tropical forest in Java, one must visit the forest reserves, or must climb high up into the mountains, where the cooler climate makes ordinary tropical agriculture impossible.

Between the villages there are extensive rice fields, or *sawahs*, rising one above the other in countless terraces, with a stream of muddy water flowing away from them beneath. At the edge

of the fields one sees rows of kapok trees (*Ceiba pentandra*), with their horizontally spreading branches, and the immense elm-like trees of *Parkia intermedia*.

Buitenzorg, the site of the famous botanical garden, is a city of some thirty thousand people, of whom nearly three thousand are Europeans. The great garden is widely advertised as an attraction to tourists, and consequently the city contains two or three good hotels. One of these, the Bellevue, is located at a corner of the garden, and has been the temporary home of scores of botanists. From the rear of the Bellevue one gets a charming view of tropical scenery. At the foot of a hill run the dark brown waters of the Tji Sadane. Across it a forest of palms and fruit trees conceals the streets of the old city, and in the background rise the forested slopes of the huge volcano Salak.

The newer part of the city is laid off with wide and regular streets, and built up with houses and shops of a curious blend of Dutch and Javanese architecture. The native part of the city bears the old Javanese name of Bogor, which is seen in its Latinized form in the title of various botanical works. It is a maze of crooked, cobble-stoned streets, seldom more than ten feet wide, and frequently only three or four, thickly lined with the small native houses, and the whole is so hidden beneath a wilderness of trees that it looks like a part of the original forest itself. These smaller lanes are of course travelled only by pedestrians, but the wider macadamized streets are crowded with every sort of transportation, from the coolie with his shoulder pole to the modern automobile.

The streets offer, also, a good exhibition of the botanical products of the region. They are lined with vendors, squatting on their heels behind a small pile of fruits or vegetables, and thronged with coolies bringing in fresh supplies. The commonest fruit is the rambutan (*Nephelium lappaceum*), which is eaten as freely and as ubiquitously as the peanut in this country. It has a leathery crimson rind, armed with numerous soft thorn-like projections, surrounding an interior which is plum-like in both appearance and taste. The closely related pulasan (*Nephelium mutabile*) is also commonly seen, in which the thorns are

replaced by obtuse rounded wart-like projections. Other common fruits are the dark rusty-brown sawa Manila (*Achras Sapota*), the nanas or pineapple, the dark-purple, spherical mangosteen (*Garcinia mangostana*), the dull-green, heavy, thorny durian (*Durio zibethinus*), the yellow-green duka (*Lansium domesticum*), the mango (*Mangifera indica*) in many varieties, and a score of less important species. The tourist, especially if he is of a botanical turn of mind, samples all of these, and invariably selects the mangosteen as the choicest one of the lot. The fruit is the size of a small orange, and has an interior similarly divided into five to seven segments. The rind is thick, red within, with a yellow milky juice, and unpleasant to taste. Some of the segments bear a single large seed, but in most of them the seeds are abortive. The taste seems to unite something of the flavors of pineapple, strawberry, and peach.

The natives themselves appear to relish the durian next to the rambutan. In fact, the chief reason for the popularity of the latter is probably its cheapness, since one can purchase a bunch of twenty for less than a penny of American money, while a single durian costs two cents. The durian fruit is the size of a large grape-fruit, somewhat ellipsoidal in shape, and densely covered with extremely stout and sharp conical thorns. Considering that a single fruit weighs two pounds or more, and grows on a tall tree, one can understand that there might be serious consequences if a fruit should fall from a tree on some unlucky passer-by. Near the railway station a huge durian tree, loaded with fruit, overhung the street, and we never passed under it without a little apprehension.

Inside the heavy outer rind, a durian contains five compartments, each with a single seed embedded in a white pulpy aril. Five natives generally club together to purchase and eat a durian, and such groups are frequently seen squatting at the roadside. They seem to relish it for its food value rather than its flavor, which has been both praised and maligned by travellers. Its notorious and unsavory odor is not very apparent in a single specimen, but a pile of a hundred or so, in front of a *toko* for sale, may be apprehended by the nostrils from a considerable

distance. The flavor of the custard-like pulp may be compared to ice-cream flavored with onions. The thorny rind, by the way, seems to be the only object upon which the barefoot natives can not walk with impunity.

Besides the fruits, the botanist is always interested in the numerous kinds of vegetables or other plant products offered for sale, sometimes along the streets, but in greater variety in the large public market. There are huge corms of taro (*Colocasia antiquorum*), bread-fruit (*Artocarpus incisa*) and jack-fruit (*A. integrifolia*) of all shapes and sizes, djahe, the large rhizome of the zingiberaceous *Alpinia galanga*, kunjir, the small rhizome of *Curcuma longa*, hondje, a huge zingiberaceous fruit, bamboo sprouts, yams, sweet potatoes, pods of the legume *Parkia intermedia*, manihot roots, strings of betel nuts, neat bunches of sirih leaves (*Piper Betle*), and naturally a wide variety of plantains and bananas.

Neither is the use of these various tropical plants confined to the natives. The vegetable stews served at *rijsttafel* at the hotel always contained some fresh surprise, which was identified, if at all, only with considerable difficulty. We found bread-fruit seeds, palm pith and palm cabbage, ginger roots, various sorts of unknown leaves, and even the fruits of Gnetum.

One can not appreciate the luxuriant vegetation of the botanical garden without some knowledge of the climate. Probably in no other place is there a climate of greater uniformity. From the coldest month to the warmest month, the mean temperature varies only a couple of degrees. At night, the minimum temperature is about 70°; in the middle of the day, the maximum rises to about 90°. The rainfall, amounting to about 180 inches in the year, shows a slight distinction of wet and dry seasons, but so slight is it that it makes no appreciable difference in the vegetable life.

Day after day goes by in Buitenzorg with exactly the same weather. The mornings begin clear and cool, but the steamy air rapidly grows warmer, until by noon it is uncomfortably hot. All morning, also, the clouds have been gathering around the summit of the Salak, or the even larger Gedeh, and descending

in increasing numbers into the valley. About two o'clock the storm breaks, and for a couple of hours the rain falls in torrents. Europeans and Americans pass the time by taking their daily siesta, and traffic on the streets ceases almost completely. By six o'clock the rain is over, the sun sets in a blaze of glory, and there follows an evening of delicious balminess which can not be surpassed. At this time the Tji Liwoeng, the river which flows through the garden, is a torrent of brown water, but by next morning it has shrunk to an insignificant stream, and one can cross it almost anywhere on the boulders in its channel.

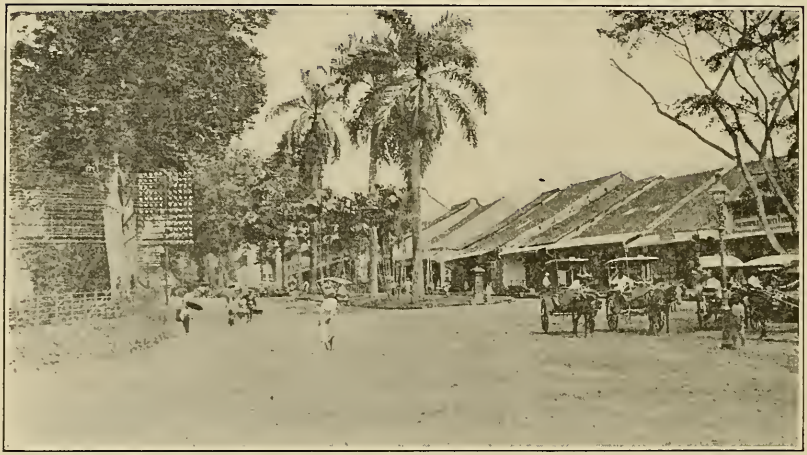

FIG. 13. The Groote Weg in Buitenzorg. The corner of the botanical garden appears at the left.

The efficiency of the Javan stream systems in carrying off the huge daily rainfall is indeed remarkable.

The great botanical garden is of course the center of interest in Buitenzorg. It lies along the Groote Weg, or main street through the city, and occupies almost 160 acres of ground. It is fairly compact in shape, but is divided naturally into three distinct parts, each of different age. The largest part, nearest the main street, represents the old garden, and is in the highest state of cultivation. It is bounded on its farther, or eastern side by a part of the Tji Liwoeng. Over the stream lies the Island, more recently added to the garden, and still showing signs of

newness. Beyond the second channel of the river, and therefore on the mainland again, lies a sort of experimental garden, called by the Dutch the Proeftuin. These three portions are all connected by bridges across the river, but the main entrances to the garden are all from the Groote Weg, and therefore into the main portion of it. North of this, and scarcely separated from it, is the palace of the governor-general, with a deer park behind it.

The visitor's first view of the garden is from the Groote Weg, as he drives from the railway station out to the hotel. On one side of the street is an iron fence, and over the fence ostensibly a forest. If it were not for the frequent walks through the tangle of vegetation, or the glimpses of labels at the base of trees, he might easily suppose it was a forest. Because, it must be known, a botanical garden in these tropical lowlands is entirely different from one in America. There is almost no attempt to secure the long vistas, the open grass plots, or other conventions of landscape architecture. Nor should there be, because such effects would be as completely out of harmony with tropical vegetation as they are in harmony with the plant life of the temperate zone. The charm of the garden lies in its marvelous wealth and density of vegetation, and that must be heightened if possible, by plantings in dense masses, by paths disappearing into apparent jungles, by short vistas closed by opaque masses of foliage, and by tree trunks and branches concealed under epiphytes and lianas. So the tourist is pleased by the garden, not for any similarity which it bears to American parks and gardens, but by its remarkable dissimilarity.

For practically a century the garden has been growing in size and in importance. Its growth was suddenly accelerated some forty years ago, when Melchior Treub assumed the directorship, and its present high development is due chiefly to his energy and zeal. Under the present direction of Dr. Konigsberger, to whom the writer is indebted for many courtesies, the scientific policies of Treub are being continued, and even better facilities offered to visiting botanists.

It was Treub who first opened the garden to botanists from other lands, and who built the first laboratory for visitors.

During the thirty-odd years that foreigners have been welcomed, some scores of them have worked there. In fact, most of the leading botanists of Germany and Austria have studied there, as well as many from other European countries. Most of the contributions to our knowledge of tropical morphology, physiology, and ecology have been developed there, and one can even now see still growing some of the actual plants with which Goebel, Haberlandt, or Schimper worked. It is a matter of great regret that more Americans have not used the wonderful opportunities offered at the garden, for we were the ninth and tenth Americans to register our names in the visitors' book at the laboratory.

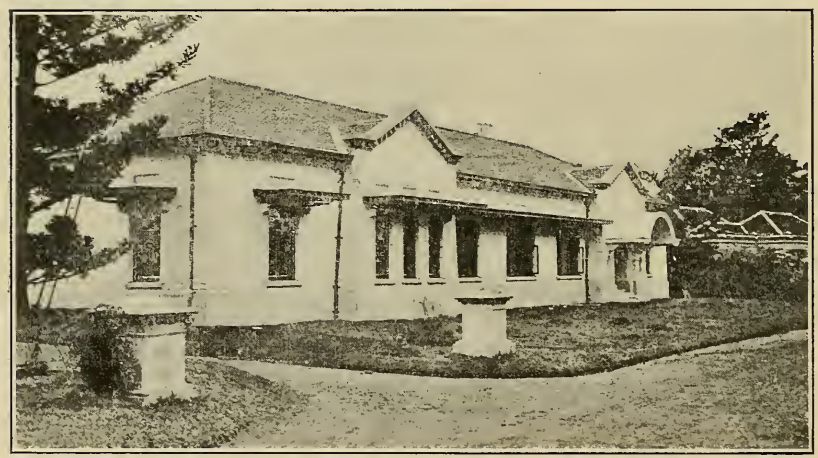

FIG. 14. The new Melchior Treub Laboratory for foreigners at the botanical garden, Buitenzorg, Java.

The buildings of the garden are all at the corner of the Groote Weg, and consequently easily accessible. There are several of them, all one story in height, with tile roofs and white stucco walls. All are small in size, since it is more comfortable to build many small buildings than few larger ones. Some of them are used for experimental work connected with the garden proper or with the Department of Agriculture; some for administration, museums, or work-shops; one is the residence of the director; but only two will be of much interest to the visitor. These are the laboratories for foreigners.

The old laboratory is a very plain rectangular building of one large room. One end of the room is a veranda, with a dark-room opening from it. On one side of the room are windows. The other side and end are wall, covered with shelves and cupboards, but with a door leading to another broad veranda, from which opens the office of the director of the laboratories, Dr. von Faber. Plain laboratory tables face the windows on one side. Larger tables stand in the middle of the room, but to get running water one must go to the veranda. A small bookcase contains a working collection of books, mostly systematic. Microscopes, ordinary apparatus and glassware, and reagents are provided freely. Heavier apparatus is stored in outbuildings near by. Native carpenters or mechanics are always ready to help with the construction of special apparatus. A native servant is in the laboratory, but must be addressed in the Malay language. Plant material is supplied in the greatest profusion upon application to the director. In fact, there seems to be almost no limit to the kind or quantity of plants that the botanist may ask for and receive.

The new Treub laboratory was nearing completion during our stay at the garden, and has since been opened. It is a handsome and commodious building, of the usual one-story tile-roof style, but with high ceilings and plenty of windows. The ends of the rectangular building are occupied by offices, a chemical laboratory, dark-rooms, library, and store-rooms, while the large center is the laboratory proper. It is incompletely divided by partial walls, extending from the sides into the room, into six compartments, three on each side. Each compartment has its own window, and the style of construction assures sufficient isolation to each worker, while not interfering with the free circulation of air.

One misses glass-houses from the garden buildings, but they are of course unnecessary. Their place is taken, in a way, by shade houses, covered with wooden lattice only, and used especially for orchids, ferns, begonias, and other shade-loving species. Of course most of the sixteen thousand species in cultivation grow in the garden with no artificial protection.

It is the plan of the garden to have each species represented by at least two individuals, planted at such a distance from each other that both would not likely be injured at once. Even then several species are lost from the garden each year, but their loss is compensated by the annual arrival of some hundreds of new species, so that the garden shows a steady growth.

It would seem that most of the species are represented by these two individuals only, because very few species attract attention by their abundance. Certain palms, especially the betel, the coconut, and the royal palm, are rather freely planted

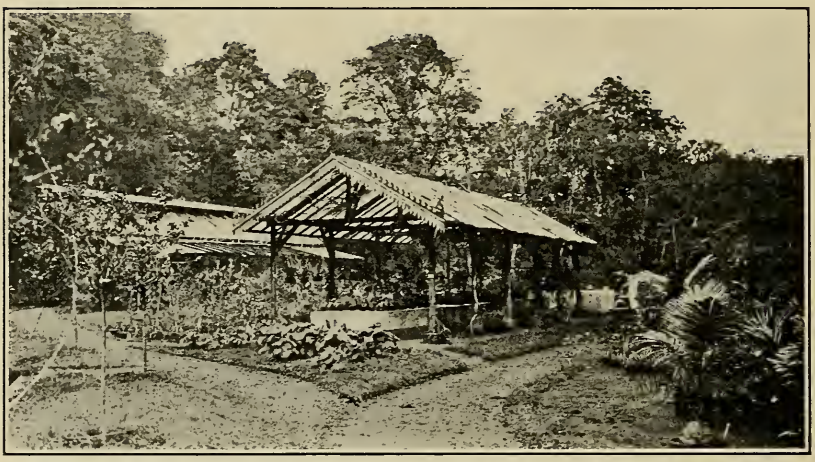

FIG. 15. A shade house in the botanical garden, Buitenzorg, Java.

along the avenues; the canary trees, *Canarium* spp., are planted along both sides of the famous canary avenues; the huge legume *Parkia intermedia*, is rather common; *Ficus indica* and *F. religiosa* are frequent; the giant bignoniad, *Spathodea campanulata*, is planted in many places, and keeps the ground beneath littered with its huge red flowers. But aside from these, which form merely trifling exceptions among the great multitude of plants, the whole garden presents the general effect of endless variety of species.

The main entrance to the garden is through a gateway from the Groote Weg, almost hidden behind the drooping leaves and

immense flower clusters of *Amherstia nobilis*. It leads directly to the famous Canary Avenue, one of the chief show places of the garden. The avenue is perfectly straight, about one third of a mile long, well macadamized, and shaded by two rows of immense canary trees, whose elm-like crowns arch over and meet above the road in a continuous canopy of foliage nearly a hundred feet above the driveway. The canary trees themselves are noble in appearance, but the tropical beauty of the avenue is not due to them alone. At the base of every tree leafy lianas have been planted, Fagraeas, Freycinetias, Gnetums, but chiefly

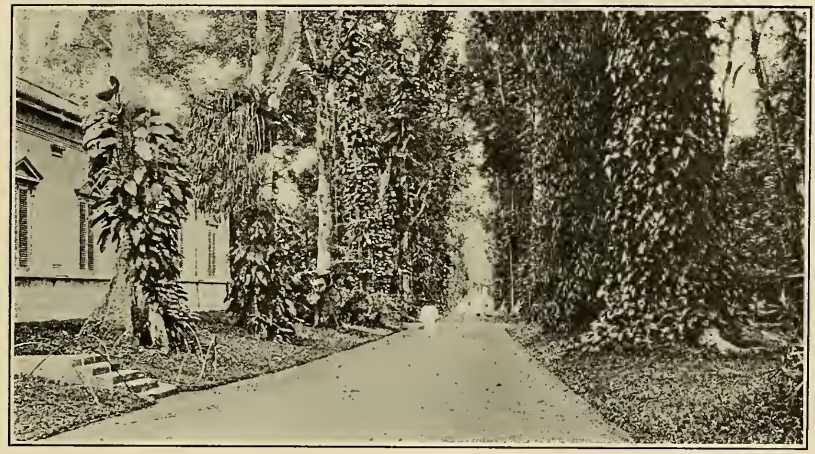

Fig. 16. Canary Avenue from near the main entrance, Buitenzorg. The second tree from the left supports the huge orchid *Grammatophyllum speciosum*.

huge aroids, which completely cover and hide the tree trunks as high as the lower branches. Besides these, hundreds of bird's nest fern (*Asplenium nidus*), and various other epiphytic ferns and orchids have colonized on the branches and trunks, until the avenue has become almost a tropical garden in itself.

Unfortunately the canary trees are rather short-lived, and preparations have already been made to replace this avenue. Another one has been planted running the length of the island and the lianas have already started to climb the trees. By the time the original Canary Avenue has begun to deteriorate, the new one is expected to be at its prime.

From the inner end of Canary Avenue, in front of the palace of the governor-general, a formal avenue of royal palms leads to another gate. From these avenues as a base, other walks and drives extend through the whole garden, always past plants of great botanical interest, but never past any single scene with as much attraction for the ordinary tourist as the famous Canary Avenue.

The botanist can easily spend a whole day along this avenue alone, examining the lianas and epiphytes. Among the aroids, several species of our common greenhouse genus *Philodendron* are planted, as well as various other genera seldom seen in cultivation in America. Few of them have developed the long pendent aërial roots, so frequently seen in the Philippine forest, although they are all root-climbers. In many cases roots have reached the ground from somewhere along the stem, so that the stem itself is no longer essential. The stem of one big *Philodendron*, four inches in diameter, was completely dead and severed from the ground, while for two or three feet the wood was eaten away by termites until only the bark remained. Still a few of these roots reaching the ground were sufficient to keep the plant in a flourishing condition.

From a physiological standpoint at least, there are two kinds of these aërial roots. One serves for holdfasts only, and such roots are diageotropic, or nearly so. If there is any deviation from the horizontal position around the tree-trunk, it is usually upward, making them slightly negatively geotropic. The whole root, even to the extreme tip, is closely appressed to the bark, indicating a strong thigmotropism, although their uniform direction, not influenced by irregularities in the bark, indicates that the thigmotropic response is subordinate to their diageotropism.

The second kind of root is always positively geotropic and sends out absorbent roots if it finally reaches the ground. These roots are also strongly thigmotropic, and two of them may sometimes parallel each other around all sorts of crooks and turns for three or four feet. In this case the thigmotropism seems to outweigh the geotropism, for a root may make abrupt turns to

the horizontal, following some ridge of bark, or a holdfast root, to its end, and then again turn downward.

Some species of aroids produce one kind of root, some another, and a few produce both. One species of *Philodendron* produces a geotropic root from each alternate leaf, and, since the leaves are two-ranked, all the roots appear on the same side of the stem, and grow down the tree-trunk in a flat bundle because of their strong thigmotropism. Several of the aroids begin producing geotropic roots at an early stage, which soon aid materially in water-conduction. The upper part of the stem, supplied not

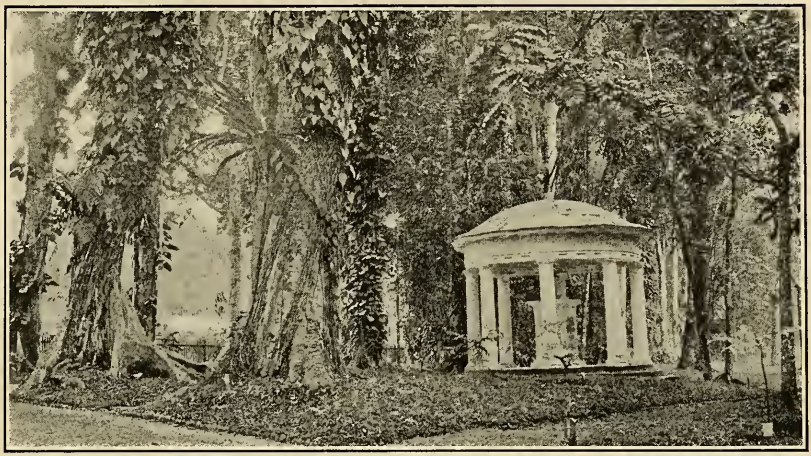

Fig. 17. Lady Raffles' tomb on Canary Avenue, botanical garden, Buitenzorg, Java.*

only from below in the normal fashion, but also from the aerial roots, is larger in diameter, and presents the phenomenon of a stem enlarging upward. None of the Buitenzorg aroids, however, show this peculiarity as well as the Philippine *Rhaphidiophoras*.

At the north end of Canary Avenue is a huge tangle of *Gnetum latifolium*. The trunk is six inches in diameter at base, and

* Lady Raffles was the wife of Sir Thomas Stamford Raffles, an English colonial governor and administrator in Java and Sumatra (1781-1826). *Rafflesia*, one of the most remarkable parasitic plants in the world, was described by Robert Brown in 1821, from plants discovered in 1818 in Sumatra. The flowers are often three feet across.—Ed.

ascends to about sixty feet in many loops and tangles. The leaves remind one greatly of those of *Celastrus scandens*. At other places in the garden are similar immense tangles of Gnetums, which produce a very dense shade. The systematic collection of Gnetums, located on the island, is composed of smaller plants, but includes several different species. Many of them exhibit the racemes of ellipsoidal fruits in various stages of maturity.

At the south end of Canary Avenue, near the main entrance, are several legumes of ecological interest. Plants of *Humboldtia laurifolia* reach a height of about 25 feet, with crooked irregular spreading branches, which at first sight appear diseased. Numerous ants are seen running on the trunk and collected on the branches. They are particularly numerous under the coriaceous appressed stipules, on the younger internodes where there are scale insects, and in and around the racemes, where they appear to be feeding, but upon what could not be ascertained. Their nests are inside the internodes, which are hollow and in the younger twigs somewhat clavate in shape. Here they cut a hole about two mm. in diameter just opposite the leaf. When the internodes become old, hard, and woody, the nests are deserted. The orifice then becomes surrounded with callus, and the whole wound becomes half an inch or more across, producing the general diseased appearance of the tree. It is obviously out of the question to try to draw any new conclusions here concerning the relation of plant and ant, but it may be remarked that when a pencil point or small stick was presented to these ants, they ran away or dropped off the twig completely.

Another legume, *Brownea grandiceps*, has a similar general appearance. Here the large spherical flower buds are covered with ants, although there is nothing apparent for them to feed upon. These ants are fierce, and vigorously attacked the point of a pencil when presented to them.

Various other myrmecophilous plants are frequently seen in the garden. *Acacia sphaerocephala*, with its hollow thorns and food-bodies terminating the leaflets, grows just as described years ago by Belt. Several species of the moraceous shrub *Conocephalus* have lanceolate appressed stipules, up to two

inches long, behind which ants make their nests. *Conocephalus* bears its leaves in terminal clusters, and since seldom more than five leaves are in each cluster, the ants must keep moving their nests at short intervals. Species of *Hydnophytum* and *Myrmecodia* are frequently seen, with large swollen tuberous bases, perforated with numerous holes and inhabited by ants. Since these plants are epiphytes, one can easily understand that these swollen bases are organs for water storage rather than definite myrmecophilous adaptations.

(To be continued)

A SIMPLE METHOD OF MAKING CARBON LEAF IMPRESSIONS

By E. D. Merrill

With the present development of photography it is usually a very simple matter to photograph any botanical specimen when a graphic representation of a borrowed type, or one examined in some distant herbarium, is desired for future reference. It sometimes happens, however, that it is not always practicable to make photographs, or to have them made, in which case recourse may be had to the simple, rapid, and effective method of making leaf impressions indicated below.

It is quite unnecessary to argue the value of graphic illustrations of plants or parts of plants, for the utility of botanical illustration is everywhere acknowledged. In a surprisingly high percentage of cases the graphic outline of a characteristic leaf of a type or typical specimen is of the very greatest value in supplementing the published description of a species, and in assisting the systematist in future identifications. In some families of plants, notably in the monocotyledons, leaf outlines will prove to be of little value in making ordinary determinations, and the same applies to certain families and genera of dicotyledonous plants. Generally, however, all broad leaved plants are adapted to the method of outlining described below, and carbon rubbings or impressions of such leaves are of the very greatest value in